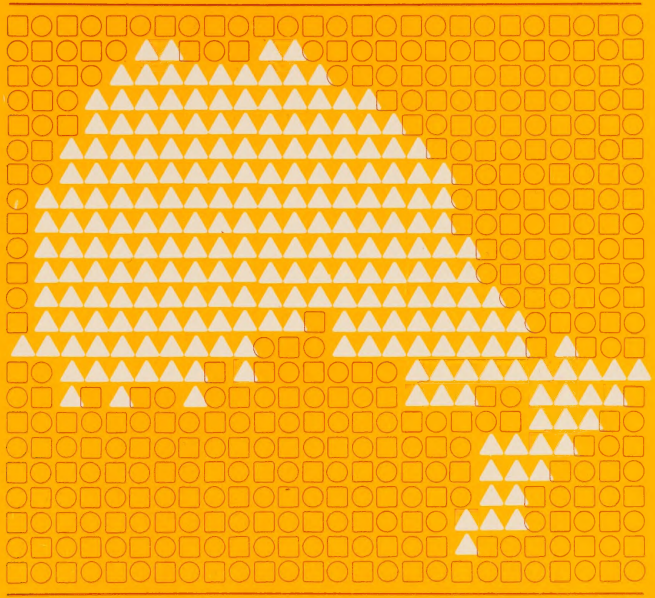
Ontario
Ministry of
Labour

Occupational
Health and Safety
Division

Designated Substances in the Workplace: A Guide to the Silica Regulation



Designated Substances in the Workplace: A Guide to the Silica Regulation

February 1986

Additional copies of this and other Ontario Government publications are available from

The Ontario Government Bookstore, 880 Bay Street, Toronto for personal shopping. Out-of-town customers write to Publications Services Section, 5th Floor, 880 Bay St., Toronto M7A 1N8. Telephone (416) 965-6015. Toll free long distance 1-800-268-7540; in area code 807 dial 0-Zenith 67200. Mastercard and Visa accepted. Cheques and money orders payable to the Treasurer of Ontario. Prepayment required.

ISBN 0-7729-0932-6

Table of Contents

Introduction

The guide has been prepared to help employers, workers, members of joint health and safety committees, supervisors and occupational health personnel meet the requirements of the designated substance regulation respecting silica in the workplace and to understand the responsibilities this regulation places on all participants in the workplace health and safety system.

The advice in this guide is the interpretation, by officials of the Occupational Health and Safety Division, of the Occupational Health and Safety Act (the Act) and regulations.

The advice does not have binding effect but is intended to provide general answers to possible questions asked in the context of a specific situation. It is being used by staff of the ministry to assist in the administration of the silica regulation.

Questions of construction and application will find their ultimate answer given by the courts where a contest ensues as to the construction or application of a legislative provision.

The Occupational Health and Safety Division of the Ministry of Labour is responsible for administering the Act. One of the oldest recognized occupational hazards, silica became the seventh designated substance to be regulated under the Act. The Regulation respecting Silica, Ontario Regulation 769/83 was filed with the Registrar of Regulations on December 9, 1983. The provisions relating to the assessment came into force on the date of filing; those relating to control measures came into force on March 8, 1984.

This guide is intended as a supplement to the booklet entitled **Designated Substances in the Workplace: A General Guide to the Regulations** to help employers meet the requirements of the silica regulation. It reviews the health effects of silica, its uses and the forms of workplace exposure. In addition, it provides information on the application of the regulation, allowable exposure levels, the assessment and control program, and medical surveillance.

It is important that both this guide and the general guide to the regulations referred to above be consulted.

For further information on any aspect of the silica regulation, you should contact the Inspectorate of the Ministry of Labour at the appropriate district office. Appendix 3 lists the addresses and telephone numbers of the District Offices of the ministry. Appendix 4 gives a list of further reading materials that may be helpful in understanding the background to the requirements of the regulation.

1. The Hazards of Silica in the Workplace

What Is Silica and How Is It Used?

Silica is a compound containing one atom of silicon (Si) and two atoms of oxygen (SiO_2). It can occur naturally as crystalline (periodic, regular distribution of atoms) or as amorphous (non-periodic, random distribution of atoms) material. Crystalline silica is significantly more toxic than amorphous silica; therefore, for health reasons, only the crystalline varieties are regulated. There are several forms of crystalline silica, of which three may be encountered in the workplace: quartz, cristobalite and tridymite. Of these, quartz is the most abundant and constitutes over 30 per cent of the Earth's crust.

Silica can also combine with metals to form silicates, such as feldspars and the different forms of asbestos. The health effects of silica and silicates differ significantly, and to distinguish silica from the silicates, it is commonly referred to as free crystalline silica, meaning it is that form of silica which is crystalline and not chemically combined with any metals.

In nature silica or quartz may occur as a pure substance (e.g., beach sand, moulding sands) or in physical combination with clays, feldspars and other silicates.

Reference should be made to the data sheet on silica prepared for Ministry of Labour inspectors and reproduced in Appendix 4 for more detailed information on the nature and properties of silica.

Table 1 shows the range in content of free crystalline silica in various bulk materials that may be encountered in industry.

TABLE 1

Free Crystalline Silica Content of Various Materials

Material	Range of Crystalline Silica (%)
Foundry Moulding Sand	0-90
Road Rock	0-80
Buffing Wheel Dressings	0-60
Clay	0-40
Ontario Gold Mines (in the rock)	0-35
Brick and Tile Compositions	10-35
Pottery Ware	15-25
Naturally containing products such as feldspar, mica, talc and limestone	up to 25

The qualities of hardness and resistance to mechanical and chemical alterations make silica a valuable substance in several industrial processes.

Silica is used in sandblasting; manufacture of abrasive, grinding and scouring compounds; moulds for castings; fillers for paints and mastic; manufacture of glass, optical equipment, pottery, ceramics, electronic components, fibreglass, and radio and TV components.

Silica flour (a finely powdered form of silica) is used in the manufacture of abrasive cleaning powders and cement blocks. However, no distinction is made between silica flour and other fine particles of silica in the silica regulation.

Why Is Silica a Health Hazard?

The prolonged inhalation of dust containing free crystalline silica results in a disease known as silicosis. Silicosis is a pneumoconiosis (a lung disease caused by the inhalation of dust) characterized by progressive fibrosis of the lungs and marked by shortness of breath and impaired lung function and may give rise to complications sometimes resulting in death. These harmful effects can be prevented by adherence to a comprehensive silica control program.

Crystalline silica may be harmful following a high dose received over a relatively short period of time (acute silicosis) ranging from a few weeks to four or five years or after long-term exposure to lower doses (chronic silicosis).

Acute silicosis is a lung disease that develops rapidly. As few as eight to 18 months may elapse from the time of first exposure to the onset of symptoms, which include progressive shortness of breath, fever, cough and weight loss. There is a rapid progression of respiratory failure usually resulting in death within one or two years. Acute silicosis has been found to occur among workers in the following occupations: sandblasting, sand pulverizing, rock drilling in quarries and the manufacture of abrasive soaps.

Chronic silicosis is similar to acute silicosis but has a much longer latency period, usually more than 10 years, before symptoms occur and may progress and worsen over a period of many years. Chronic silicosis may be either a simple or a complicated type. Simple silicosis is almost entirely without symptoms. The earliest signs may include cough, sputum and breathlessness. In the early stages of the disease the lung nodules are small (usually 1 to 3 mm) and discrete in the upper lung fields. As the disease progresses the nodules increase in number and size and also occupy the lower lung field.

Complicated silicosis is accompanied by increased breathlessness, a persistent cough and a restrictive ventilatory defect as well as impairment of gas transfer in the lung. As well as cardiac and respiratory failure, silicosis also increases the risk of tuberculosis and other recurrent chest infections.

What Form of Silica Can Be Dangerous to Workers?

Free silica occurs naturally in two forms, crystalline, and amorphous. Inhalation of free silica dust (crystalline) is the exposure of concern with respect to the health of workers. Free crystalline silica existing as quartz, cristobalite and tridymite are the three most common forms of silica that may be inhaled and result in silicosis.

Respirable quartz is that portion of the airborne free crystalline silica which, due to its size, is inhaled deeply into the lungs and reaches the alveoli; most of the dust particles have an aerodynamic diameter less than 5.0 micrometers (μm).

Silica dust may be generated through processes such as:

- drilling
- blasting
- grinding

- crushing
- sandblasting
- transporting of silica or silica-containing material
- pouring of silica or silica-containing material
- sand moulding in foundries.

How Does Silica Enter the Body?

Most occupational exposure to silica occurs through breathing in the dust. Among particles that are inhaled, those with an aerodynamic diameter larger than about 10 micrometres (μm) are essentially all removed in the nasal passages and upper airways. About 50 per cent of particles of 5 μm in diameter penetrate further than the nose during normal breathing. Particles of 0.5 μm to 5 μm in diameter are carried into the smaller airways and alveoli and are deposited there. Extremely small particles less than 0.5 μm in diameter are mostly exhaled.

The small particles of silica dust that are not expelled from the lung remain in the lung and are deposited in lymph nodes. The reaction of the body to these particles often shows on the chest X-ray. After a time, calcium can deposit in those nodes and settle along the rim of the lymph node. This condition is known as "egg-shell" calcification. Silica particles are carried into the lungs of some people. The lung forms a scar around the particles and the hardened scars gradually start to show up on the chest X-ray as fibrosis of the lung.

The proportion of dust particles that are respirable (small enough to penetrate to the alveoli) varies. Typically, in industrial dust clouds, as little as five per cent to more than 50 per cent by weight of the dust may be respirable.

2. The Silica Regulation

Who Is Covered by the Silica Regulation?

With the exception of construction projects (explained below), the regulation applies to every employer and worker at a workplace where crystalline silica in the respirable form is present and at which a worker is likely to inhale silica.

Does the Regulation Apply to Construction Projects?

If the construction project is located at a workplace to which the regulation applies, then the employer responsible for the workplace is required to comply with sections 4 and 5 of the regulation with respect to the workers on the project. (Sections 4 and 5 set allowable exposure levels for airborne silica and determine the conditions under which respirators may be used as a means of complying with these requirements.)

Other construction projects are not covered by the regulation.

What Are the Allowable Airborne Concentrations of Silica?

The exposure of a worker to silica must not exceed the levels specified in the regulation:

Time-Weighted Average Exposure Concentration

The employer is obligated to reduce the TWA to the lowest practical level and strive to achieve a level of not more than 0.1 mg of silica per m^3 of air. However, the time-weighted average (TWA) exposure

of a worker to airborne silica must not exceed 0.2 mg of silica per m^3 of air.

The time-weighted average exposure of a worker is calculated on the basis of cumulative weekly exposure (40 hours), as indicated in the Schedule appended to the regulation. Examples of such a calculation are given in Chapter 6 of **A General Guide to the Regulations.**

The exposure value is to be achieved by the employer through the use of engineering controls, work practices, and hygiene practices and facilities. Only in emergencies or in cases where there are no practical or technically feasible alternatives are these allowable exposures to be achieved through the use of respirators worn by workers.

Chapter 1 of **A General Guide to the Regulations** discusses the lowest practical level of exposure and reads:

> "The lowest practical level will depend on the characteristics of the individual work site. The employer is required to adopt those engineering controls, work practices and hygiene practices that a responsible and prudent employer would put into effect, taking into consideration the plant, equipment, engineering controls and work practices in the workplace, and what can realistically and reasonably be done by way of improvement, modification and replacement.
>
> "There are a number of factors that should be considered in determining whether the lowest practical level has been obtained. Some of these factors are:
>
> 1) The extent of the health benefits that will likely be obtained from improvements or modifications to existing engineering controls, etc., in the workplace.

2) The exposure levels that were achieved in the work site in the past.

3) The exposure levels being met in similar work sites.

4) The cost of introducing new engineering controls, or modifying those already in place.

5) The technological feasibility of achieving lower exposure levels."

It must be emphasized that the lowest practical level refers to the time-weighted average exposure only. It is likely that short-term fluctuations in exposure above this level will occur.

3. Assessing and Controlling Exposure to Silica

The Assessment

Chapter 2 of **A General Guide to the Regulations** describes how to assess the extent to which workers are exposed to silica. When carrying out this assessment you must note all processes involving silica and all potential sources of airborne silica.

Table 2 presents a list of industrial processes or operations that have varying potentials for worker exposure to silica. Any work or operation of this nature should be carefully assessed for possible exposure to silica. Wherever silica dust may be generated, pay particular attention to housekeeping, work practices, and hygiene practices and facilities.

A written assessment report must be prepared and should include a summary of the information gathered and the analysis of these data. The report must state whether there is actual or potential exposure of workers to silica and whether their health may be affected. The conclusion must indicate whether or not a control program is necessary. More information on the conclusions that may be reached is outlined on page 26 of **A General Guide to the Regulations**.

It may be necessary to include air sampling as part of the assessment for silica. Chapter 6 of **A General Guide to the Regulations** explains in detail the procedures for air monitoring that should be used to determine the concentration of silica in workplace air. The silica regulation references a Measurement Code that specifies methods and procedures to be used for air sampling and

analysis required to determine compliance with the exposure limits prescribed by the regulation and to meet the requirements of the silica control program if one is required. Unless an employer can demonstrate that he is using methods and procedures that are equal to or better than these, with respect to the factors of accuracy and precision, he must follow the standard practices laid out in the Measurement Code.

TABLE 2

Typical Workplaces with Some Potential for Silica Exposure

- sandblasting
- manufacture of abrasives
- manufacture of grinding and scouring compounds
- manufacture of moulds for castings
- manufacture of fillers for paints and mastic
- manufacture of glass
- manufacture of optical equipment
- manufacture of pottery
- manufacture of ceramics
- manufacture of electronic components
- manufacture of fibreglass
- manufacture of radio and TV components
- brick and cement work
- buffing, metal polishing and grinding
- foundries (ferrous and non-ferrous)
- cutting granite
- quarries
- steel plants
- stone and clay makers

The Control Program

Engineering Controls

If a silica control program is required, it must include engineering controls to reduce the exposure of workers to silica. These controls can be grouped into the categories outlined in Chapter 4 of **A General Guide to the Regulations**. Examples of appropriate controls for some types of silica operations are indicated on the **process flow sheets** included in Appendix 1 of this guide and are discussed below.

Product Substitution

It may be possible to eliminate silica from certain processes in the workplace by replacing it with a less toxic material. For example:

- Silica sand used in abrasive blasting may be replaced by metal shot and grit, alumina, garnet, nutshells, cereal husks, sawdust, high pressure water, steel sand, silicon carbide or corundum.
- Sandstone grinding wheels may be replaced by artificial abrasive wheels (usually of aluminium oxide).
- Metal moulds may be substituted for sand moulds in foundry casting operations.
- Silica parting compounds used in foundries may be replaced by calcium carbonate.
- Olivine sand may be used to replace quartz sand in foundries. Additionally, dust levels may be reduced by adding oil instead of soot to moulding sand.
- Magnesite or aluminum oxide bricks may replace silica bricks in furnaces, vaults and ladles in steelworks.

Process Changes

In some situations silica exposure can be reduced through process changes or modifications. For instance:

- Abrasive operations that produce a coarse dust are less hazardous than those that produce a fine dust. Coarse dusts settle more readily and are less likely to be trapped in the lungs if inhaled. The substitution of a mechanical process by a manual process, for example, will result in the production of a coarser dust.
- Wet methods should be used to reduce dust where practical. For example, if rock is slowly wetted before it is moved or worked on, dust can be suppressed at the source. Wet methods can also limit dust generation in operations such as cutting and grinding. Water fogs produced by fog guns at grinders and shakeout and during transfer operations can markedly reduce dust in foundries.
- Processes can be designed to include automatic shut-off valves or warning signals wherever possible. Alarms can be installed to warn of high pressure, low or high temperature, pump failure, low or high levels and failure of ventilation systems.

Enclosure/Isolation

Processes that generate silica dust should be in enclosed systems wherever possible. Enclosure or isolation of the source of dust can be done in a number of ways. Dusty operations can be grouped and carried out in areas separated from non-dusty workplaces or they can be completely walled off from the general plant atmosphere. They may be totally enclosed in a cabinet, as is done, for example, in finishing operations in foundries. In some operations the worker can be isolated in a ventilated cab. Conveyors that transport silica or silica-containing materials can be enclosed and vented to dust collectors or baghouses.

Ventilation

Proper ventilation is particularly important in situations where harmful concentrations of free crystalline silica may arise. Ventilation systems should be designed and maintained to prevent the accumulation and recirculation of harmful concentrations of free crystalline silica in the workplace. Regular maintenance and cleaning of air filters is essential to keeping the ventilation system operating effectively.

Local exhaust ventilation and complete enclosure of processes (where practical) should be used to confine and remove dust at the source. Exhausted air should be conveyed to an appropriate air cleaning device for collection of silica dust. Sources responsible for producing high concentrations of silica dust (e.g. high production crushing, grinding, drying, screening, abrasive blasting, drilling or foundry operations) require high quality system design, installation and operation, and it is imperative that continuous surveillance and preventive maintenance of production facilities be conducted.

Good general ventilation is effective for controlling hot fumes (i.e. from melting and pouring), it is not normally effective for diluting silica dust. Local exhaust ventilation is preferable to general dilution ventilation, especially in mixers, forming machinery, grinders and conveyors. In foundries control of dust from portable grinders is achievable with down-draft benches and high velocity, low volume exhaust systems. However, it is often difficult to completely eliminate airborne silica through local exhaust ventilation alone.

Standard practices in the design of industrial exhaust systems can be found in reference texts such as **Industrial Ventilation, a Manual of Recommended Practice** published by the American Conference of Governmental Industrial Hygienists.

Work Practices and Hygiene Practices

Rigorous adherence to good hygiene practices (as outlined in Chapter 4 of **A General Guide to the Regulations**) is essential to control inhalation of silica dust. Hygiene facilities with a "double locker system" should be used whenever there is significant exposure to silica dust. Silica can accumulate on the hands, clothing and hair. From there it can be disturbed, resuspended in air and inhaled. Workers should be able to wash and shower at the end of each shift. Smoking, eating, drinking or chewing in contaminated areas must be strictly forbidden. Lunches must be stored in an uncontaminated area.

Dusty jobs can also be carried out at specific times such as the end of the shift or when most of the workers are away from the plant. Scrap receptacles for silica dust should be kept tightly covered to prevent dust from becoming airborne. Cleaning by blowing with compressed air or dry sweeping should be avoided; methods of cleaning such as vacuuming as described above or washing down with water should be used.

Housekeeping Measures

Good housekeeping is crucial wherever silica dust is generated. Silica dust must be cleaned from machinery, floors, ledges and other surfaces daily by wet sweeping or the use of sweeping compounds or special vacuum cleaners. Vacuum cleaners should be fitted with a high-efficiency particulate filter (HEPA) designed to trap silica and prevent the recirculation of dusty air.

Keeping floors wet can help to control dust levels. Cleaning and wetting of floors should be done with a fine spray of water to avoid stirring up dust.

Protective Clothing

Where exposure to crystalline free silica occurs, protective work clothing should be vacuumed before removal. Clothes should not be cleaned by blowing or shaking. Safety glasses, goggles or face shield and full body protective clothing should be worn for dusty operations, e.g. abrasive sandblasting.

Respiratory Protection

The type of respirator that should be worn to protect against exposure to silica depends on the concentration of the respirable free silica in the air and should be approved by NIOSH or an equivalent approval agency. The Code for Respiratory Equipment for Silica, which is referenced by the regulation, specifies the type of respirator required for different conditions of exposure. Use of respirators should conform to the practices outlined in Chapter 5 of **A General Guide to the Regulations**.

The Type of Respirator Required

The respiratory equipment provided by an employer and used by a worker must meet or exceed the requirements shown in Table 3:

TABLE 3

Respirator Requirements For Silica Exposure

Respirable Free Silica Airborne Concentration (calculated in terms of a factor above the time-weighted average exposure limit)	Type of Respirator Required
Less than or equal to 0.5 mg/m^3	Any dust respirator including single-use designed for protection against silica exposure.
Less than or equal to 1.0 mg/m^3	Quarter or half-mask respirator with replaceable dust filter or single use (valve-type) dust respirator.
Less than or equal to 5.0 mg/m^3	Full facepiece respirator with a high efficiency particulate filter.
Less than or equal to 10.0 mg/m^3	Powered air purifying positive pressure respirator with a high efficiency particulate filter.
Greater than 10.0 mg/m^3	A NIOSH Type C supplied-air respirator operated at pressure-demand or other positive pressure or continuous-flow mode; or any full facepiece self-contained breathing apparatus operated in positive pressure mode.

Notes:

1. Respirators need not be worn if the levels of silica are less than a time-weighted average of 0.2 mg/m^3. However, if the worker wishes to use a respirator, the correct type of respirator shall be worn.

2. Supplied-air respirator does not include a powered air purifying respirator.

4. Measuring Airborne Silica

The Code for Measuring Airborne Silica consists of three parts: the personal sampling method for silica, the determination of cristobalite on air sampling filters and the determination of alpha quartz on air sampling filters.

The principle of the personal sampling method for silica is to draw air at a specified flow rate for a known duration through a collecting medium consisting of a cyclone, which lets particles of 5 μm or less in diameter pass through to the second part, a silver membrane filter. This size selective sampling equipment simulates the deposition pattern of particles in the lung. The cyclone rejects non-respirable particles of an aerodynamic diameter in excess of 5 μm and passes the rest to the collecting filter. Generally, sampling is carried out for a full work shift or for the duration of the operation during which the worker is exposed to silica.

The second part of the code gives the appropriate analytical technique for measuring either of the common forms of crystalline silica, namely cristobalite or quartz. Each filter is analysed by X-ray diffraction to detect signal peaks for quartz and/or cristobalite. These peaks are referenced to standards to confirm the presence of crystalline silica, and the intensity of the peaks is used to estimate the amounts by comparison with calibration curves. The weight of quartz or cristobalite present in a sample is estimated, using two different diffraction peaks in order to avoid errors due to interference.

Knowledge of the absolute mass collected on the filter and also of the air volume sampled permits a determination of the air

concentration of crystalline silica. The time-weighted average (TWA) exposure of the worker is then calculated according to the schedule appended to the regulation and is based on a cumulative weekly exposure over a 40-hour work week. Examples of how to calculate the TWA exposure of a worker are given in Chapter 6 of **A General Guide to the Regulations**.

5. Medical Surveillance for Exposure to Silica

The silica regulation requires that the control program provide for a medical surveillance program, which must include:

- pre-employment, pre-placement and periodic medical examinations
- clinical tests
- health education
- record keeping.

The medical surveillance program is outlined in detail in The Code for Medical Surveillance for Silica and is designed to protect the health of workers through educating all staff to the health hazards associated with silica exposure.

Section 3 of the Code explains what the physician should look for at the pre-placement and periodic medical examinations. Medical records kept by the physician should include the information listed in section 7 of the Code.

Clinical Tests

Section 4 of the Code explains clinical tests that are used in assessing the worker's silica exposure and fitness for continued exposure to silica. These include X-rays and pulmonary function tests.

X-rays

A chest X-ray, postero-anterior, should be taken at least once every two years. A lateral X-ray may be done at the discretion of the examining physician. If the worker has been examined within the past year, the examining physician should obtain the worker's medical status, where possible, from the previous examination to avoid unnecessary X-rays. Especially at pre-placement examinations, radiographs should be checked for early signs of silicosis or other chest diseases by a physician who is a member of the *Canadian Pneumoconiosis Reading Panel. The panel is a group of physicians from all provinces. The examining physician should determine the duration and frequency of follow-up X-rays and surveillance. These will depend on the intensity and duration of exposure to silica.

Pulmonary Function Tests

Pulmonary function tests should be done in conjunction with the chest X-ray in accordance with section 4(2) of the Code.

Action Levels

An assessment of fitness for work should be based on the clinical examination in conjunction with the clinical tests. Before a worker is removed from exposure, the Ministry of Labour and the Workers' Compensation Board chest physicians must be consulted. The health and livelihood of the affected worker must be considered before a worker is removed from work.

---

* For more information on the Canadian Pneumoconiosis Reading Panel contact Dr. Jaan O. Roos, Senior Medical Consultant, The Occupational Health Branch Chest Clinic. Phone # 419-965-4075.

The Examining Physician

The silica regulation does not stipulate who shall be the examining physician, thus allowing the worker to select the doctor of his or her choice. As a result, the examining physician may be the company doctor, a private consultant with whom the employer contracts services, a physician on the staff of a clinic or the personal physician of the worker. Every examining physician must know the content of the Code for Medical Surveillance and his or her responsibilities. Where there is more than one examining physician, a physician should be appointed in a co-ordinating role. The role of the co-ordinating physician, who should be selected jointly by the employer and the joint health and safety committee, should be to standardize examination and test procedures, maintain medical records and identify any trends in examination and test results.

Physicians Reporting Protocol

The regulation requires the examining physician to advise the employer whether the worker is fit, fit with limitations or unfit for exposure to silica. This determination is a professional judgement based on the results of medical examinations and clinical tests. **The physician must give this opinion without disclosing to the employer the results of the examinations or tests.**

The designated substance regulation for silica requires the physician to advise the committee in writing of the results of clinical tests, along with an opinion as to how these tests should be interpreted and an opinion as to the fitness of the worker for exposure. In all such cases the committee must receive this information on a confidential basis. If the physician has advised the employer that a worker is fit with limitations or unfit, he or she must also report this information to the Chief Physician of the Occupational Health Medical Service of the Ministry of Labour. These requirements are specified in sections 16(1), 16(2) and 16(5) of the regulation.

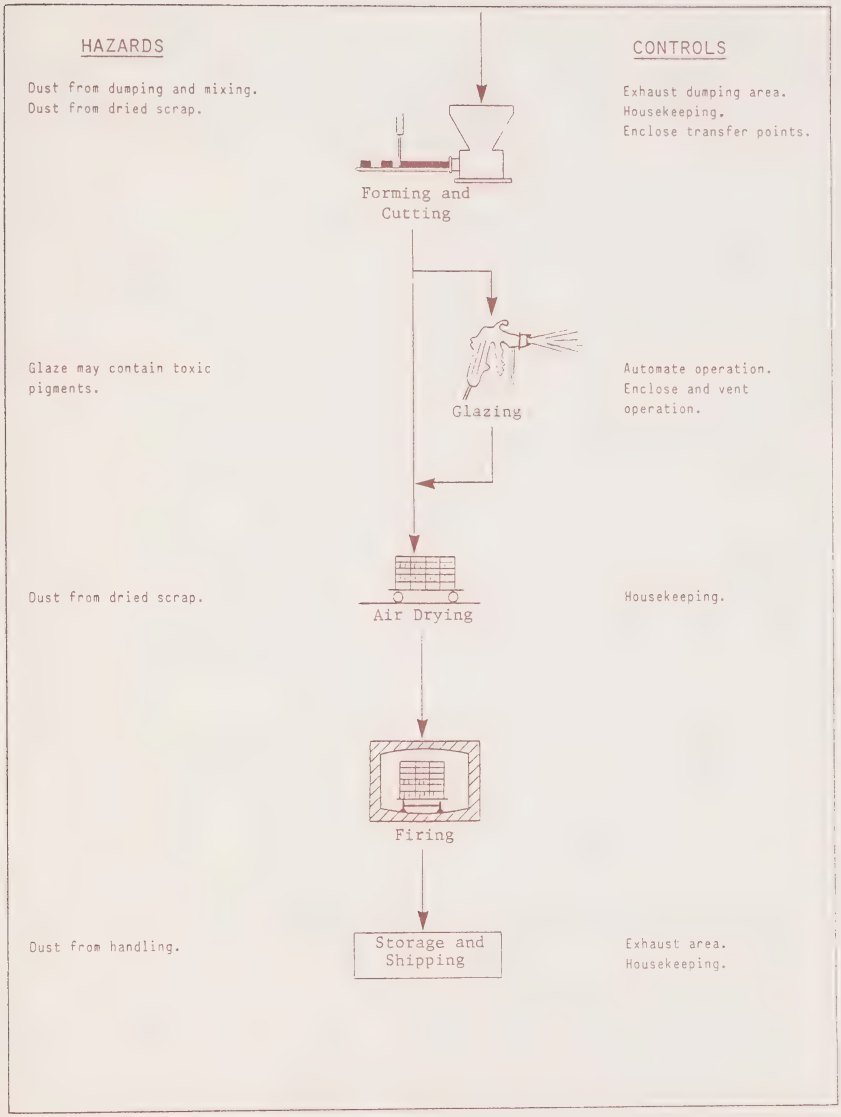
6. Appendices

Appendix 1 – Process Flow Sheets

PROCESS FLOW SHEET FOR INSPECTORS
BRICK MANUFACTURING
SILICA

HAZARDS		CONTROLS
Silica dust from quarrying.	 Quarrying	Minimize transfer operations. Suppress dust formation by wetting area and paving roads. Truck tire washing stations. Enclosed work station with filtered air supply.
Silica dust from crushing.	 Crushing	Locate crusher outdoors and away from other operations. Local exhaust at the truck dumping area and crusher openings.
Dust from transfer operations. Dust from wind erosion of storage pile.	 Conveying and Storage	Enclose conveyer. Exhaust loading and unloading areas. Wet storage pile.
Dust from grinding.	 Grinding	Enclose and exhaust grinding operation. Wet grinding. Housekeeping.
Dust from screening.	 Screening	Enclose and exhaust screening operation. Housekeeping. Wet collection or vacuuming of dust.

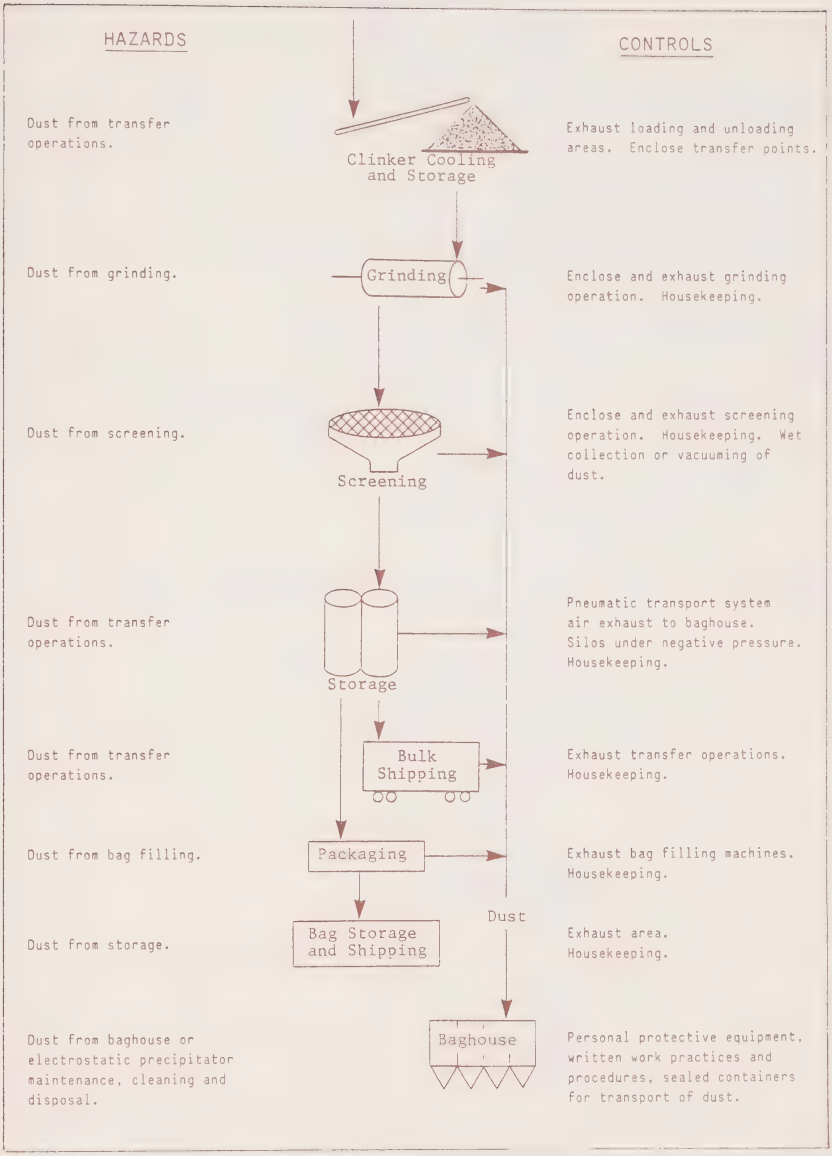
BRICK MANUFACTURING
SILICA
(cont'd.)



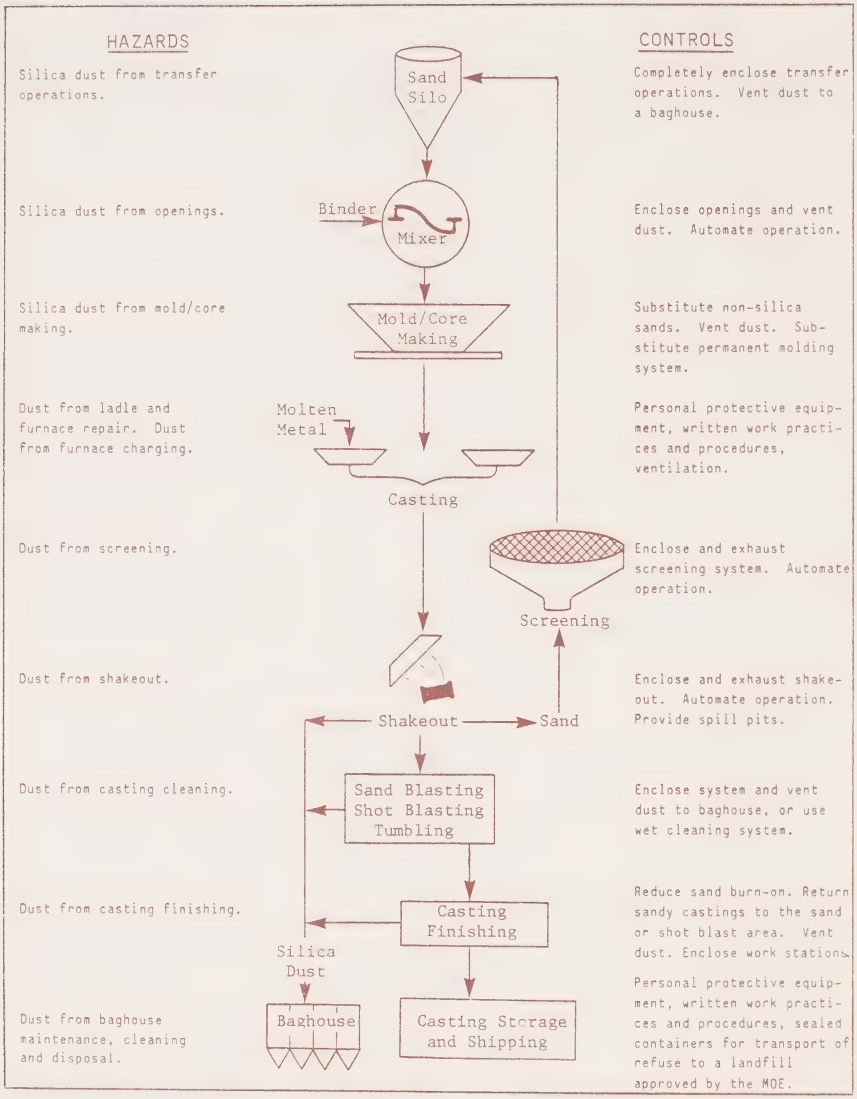
PROCESS FLOW SHEET FOR INSPECTORS
CEMENT MANUFACTURING
SILICA

HAZARDS		CONTROLS
Silica dust from quarrying.	 Quarrying	Minimize transfer operations. Suppress dust formation by wetting area and paving roads. Truck tire washing stations. Enclosed work stations with filtered air supply.
Silica dust from crushing.	 Crushing	Locate crusher outdoors and away from other operations. Local exhaust at the truck dumping area and crusher openings.
Dust from dumping and mixing.	 Proportioning and Mixing	Exhaust dumping area. Housekeeping.
Dust from grinding.	 Grinding	Enclose and exhaust grinding operation. Wet grinding. Housekeeping.
Dust from screening.	 Screening	Enclose and exhaust screening operation. Housekeeping. Wet collection or vacuuming of dust.
Dust from kiln cleaning and maintenance.	 Firing	Personal protective equipment, written work practices and procedures, sealed containers for transport of waste.

CEMENT MANUFACTURING
SILICA
(continued)



PROCESS FLOW SHEET FOR INSPECTORS
FOUNDRY SAND
SILICA



Appendix 2 – Data Sheet for Inspectors

CRYSTALLINE SILICA*

CAS. REG. NO. QUARTZ - 14808-60-7
CRISTOBALITE - 14464-46-1
TRIDYMITE - 15468-32-3

OTHER NAMES

Alpha silica, free silica, silica flour, silica sand, silicic anhydride, silicon dioxide (crystalline).

TRADE NAMES

None
Note: Other materials which may contain free crystalline silica include: Cab-o-sil; diatomaceous earth; flint; granite; sand; sandstone; tripoli.

POTENTIAL EXPOSURE

USES: Sandblasting; manufacture of abrasives and grinding and scouring compounds; moulds for casting; slagging or flux material in the smelting of metals; fillers for paints and mastic; manufacture of glass, optical equipment, pottery, ceramics, electronic components, fibreglass, radio and TV components.

OCCUPATION(S):

Abrasive sandblasters
Agriculture workers
Brick and cement workers
Buffers, metal polishers and grinders
Ceramic and pottery workers
Construction workers
Foundry workers (ferrous and non-ferrous)
Glass makers
Granite cutters
Miners, mill and plant workers
Paint and mastic formulators
Quarry workers
Steel workers
Smelter workers
Stone and clay makers

Note: Silica is a major by-product in the mining industry (mine tailings).

STORAGE

Store in closed containers or use other appropriate means to reduce potential for dust generation from stored material where practicable e.g., membrane or tarpaulin cover of stock piles, oil or water spray of stock piles.

INCOMPATIBILITY: None with most industrial materials.

LABELLING: Not applicable

EXPOSURE LIMIT (See section 4 of the Regulation respecting Silica)

TWAE: 0.20 mg/m^3

Note: 1) Worker exposure to silica must be reduced to the lowest practical level. Effort should be made to reduce exposure to at least 0.10 mg silica per m^3 of air.

2) Details of the methods for air sampling and analysis for silica are given in the Code for Measuring Airborne Silica appended to the Regulation respecting Silica.

PROPERTIES

FORMULA: SiO_2 (native quartz)
DESCRIPTION: Transparent crystal, may be coloured by impurities
ODOUR: Odourless
SPECIFIC GRAVITY (20°C): 2.66
BOILING POINT: 2230°C
MELTING POINT: 1600°C
SOLUBILITY: Insoluble in water, soluble in hydrofluoric acid

FIRE AND EXPLOSION

Not combustible.

EXTINGUISHING MEDIA: Not applicable

FLASH POINT: Not applicable

AUTO-IGNITION TEMPERATURE: Not applicable

EXPLOSIVE LIMITS: Not applicable

HAZARDOUS DECOMPOSITION PRODUCTS: None

LEAKS, SPILLS AND DISPOSAL

Minimize dust generation during clean up.

Wear suitable respirator (see safety equipment section).

Ventilate area of spill or release.

Collect material in most convenient and safe manner for reclamation or disposal.

NEUTRALIZING CHEMICALS: Not applicable

*CRYSTALLINE SILICA IS A DESIGNATED SUBSTANCE
Ontario Regulation 769/83

CRYSTALLINE SILICA

(cont'd.)

CRYSTALLINE SILICA

CAS. REG. NO.		
	QUARTZ	14808-60-7
	CRISTOBALITE	14464-46-1
	TRIDYMITE	15468-32-3

SAFETY PRACTICES

PRECAUTIONS:

Instruct workers in the proper handling of silica.

Use dust suppression techniques whenever possible.

Vacuum work clothing before removing. Do not clean clothes by shaking or blowing

VENTILATION:

Enclose operations and use local exhaust ventilation wherever possible to control silica dust.

Use adequate general ventilation in all work areas.

REPAIRS AND MAINTENANCE:

Wear suitable respiratory equipment (see safety equipment section).

Inform workers of potential hazards of silica exposure.

SAFETY EQUIPMENT

It is good work practice to use safety glasses, goggles or faceshield and full body protective clothing for very dusty operations, e.g., abrasive sandblasting.

RESPIRATORS: (See section 5 of the Regulation respecting Silica and the Code for Respiratory Equipment for Silica appended to the Regulation)

TWA CONC. (mg/m^3) (respirable free silica)	TYPE
Less than or equal to 0.5	Any dust respirator including single-use designed for protection against silica exposure.
Less than or equal to 1.0	Quarter or half-mask respirator with replaceable dust filter or single use (valve-type) dust respirator.
Less than or equal to 5.0	Full facepiece respirator with a high-efficiency particulate filter.
Less than or equal to 10.0	Powered air-purifying positive pressure respirator with a high-efficiency particulate filter.
Greater than 10.0	A NIOSH Type C supplied-air respirator operated at pressure-demand or other positive pressure or continuous-flow mode; or any full facepiece self-contained breathing apparatus operated in positive pressure mode.

Notes: 1. Respirators must not be a substitute for engineering controls (e.g., adequate ventilaton).

2. Supplied-air respirator does not include a powered air purifying respirator.

HEALTH EFFECTS - PROTECTION - FIRST AID

EXPOSURE	SYMPTOMS	PROTECTION	FIRST AID
EYES:	Irritation	Safety glasses, goggles, or face shield	Wash eyes with large amounts of water. If eye irritation persists contact physician.
SKIN:	Irritation	Gloves, protective clothing (see safety equipment section)	Wash thoroughly with soap and water.
INHALATION:	Cough, sneezing, difficulty in breathing	Use proper respirator (see safety equipment section)	Remove to fresh air.

LONG TERM: Chronic inhalation can lead to silicosis, a disabling and progressive lung disease.

Note: Where a silica control program exists, medical surveillance of silica exposed workers is required. Details of medical surveillance requirements are given in the Code for Medical Surveillance of Silica Exposed Workers appended to the Regulation respecting Silica.

ADDITIONAL INFORMATION

This data sheet is intended to impart basic information only. If additional information or specific references concerning crystalline silica are required contact your local field office of the Occupational Health Branch.

REV. 07/85

Appendix 3 – Ministry of Labour District Offices

Barrie
Industrial Health and Safety
114 Worsley Street
L4M 1M1
(705) 722-6642
1-800-461-4383*

Elliot Lake
Mining Health and Safety
10a Brunswick Walk
P5A 2A8
(705) 848-2885

Hamilton
119 King Street West
L8N 3Z9
Construction Health and Safety
Industrial Health and Safety
(416) 521-7736
1-800-263-6906(8)*

Kingston
1055 Princess Street
K7L 1H3
Construction Health and Safety
Industrial Health and Safety
(613) 547-3414
1-800-267-0915*
Mining Health and Safety
(613) 547-3418
1-800-267-0915*

Kirkland Lake
Mining Health and Safety
4 Government Road East
P2N 1A2
(705) 567-5241

Kitchener
824 King Street West
N2G 1G1
Construction Health and Safety
Industrial Health and Safety
(519) 744-8101
1-800-265-8723*

London
205 Oxford Street East
N6A 5G6
Construction Health and Safety
Industrial Health and Safety
Mining Health and Safety
(519) 439-3231
1-800-265-4707*

North Bay
Industrial Health and Safety
1500 Fisher Street
Northgate Square
P1B 2H3
(705) 476-2711
1-800-461-1654*

Ottawa
2197 Riverside Drive
K1H 7X3
Construction Health and Safety
Industrial Health and Safety
(613) 523-7530
1-800-267-1916*

Peterborough
139 George Street North
K9J 3G6
Construction Health and Safety
(705) 742-3436
1-800-461-1425*
Industrial Health and Safety
(705) 876-1800
1-800-461-1425*

Richmond Hill
Mining Health and Safety
10720 Yonge Street
L4C 3C9
(416) 884-6551
1-800-268-3829*

St. Catharines
205 King Street
L2R 3J5
Construction Health and Safety
Industrial Health and Safety
(416) 682-7261
1-800-263-7260*

Sarnia
Industrial Health and Safety
700 Christina Street North
N7V 3C2
(519) 336-1200
1-800-265-1416*

Sault Ste. Marie
390 Bay Street
P6A 1X2
Construction Health and Safety
Industrial Health and Safety
(705) 949-3331

Sudbury
199 Larch Street
P3E 5P9
Construction Health and Safety
Industrial Health and Safety
(705) 675-4455
Mining Health and Safety
(705) 675-4464
1-800-461-4000*

Sudbury
260 Cedar Street
P3B 3X2
Mining Health and Safety
(Chief Engineers)
(705) 675-4468
1-800-461-4000*

Thunder Bay
435 James Street South
P7E 6E3
Construction Health and Safety
Industrial Health and Safety
(807) 475-1691
1-800-465-5016(7)*
Mining Health and Safety
(807) 475-1675
1-800-465-5016(7)*

Timmins
273 Third Avenue
P4N 1E2
Construction Health and Safety
Industrial Health and Safety
Mining Health and Safety
(705) 267-6231
Zenith 57740* (Mining)

Toronto East
2500 Lawrence Avenue East
Scarborough
M1P 2R7
Construction Health and Safety
Industrial Health and Safety
(416) 750-3557
1-800-268-6541*

Toronto West
2 Robert Speck Parkway
Mississauga
L4Z 1H8
Construction Health and Safety
Industrial Health and Safety
(416) 273-7800
1-800-268-2966(7)*

Windsor
500 Ouellette Avenue
N9A 1B3
Construction Health and Safety
Industrial Health and Safety
(519) 256-8278
1-800-265-5140(4)*

Occupational Health Branch Laboratory
101 Resources Road
Weston, Ontario
M9P 3T1
(416) 248-7261

Head Office
400 University Avenue
Toronto, Ontario
M7A 1T7

Construction Health and Safety
(416) 965-7161
1-800-268-8013*
Industrial Health and Safety
(416) 965-4125
1-800-268-8013*
Mining Health and Safety
(416) 965-1328
1-800-268-8013*
Occupational Health
(416) 965-3211
1-800-268-8013*
Special Studies and Services
(416) 965-2493
1-800-268-8013*
Standards and Programs
(416) 965-8710
1-800-268-8013*

*Toll free line. For callers located within the area code but outside the local calling area of this city. Consult the blue pages in your local telephone directory for additional information. The Ministry may also be reached 24 hours a day through the emergency telephone number in Toronto (416) 965-1211.

Appendix 4 – Supplementary Reading Materials

1. Report on the Designation of Silica in Ontario, Ontario Ministry of Labour, December 1982.

2. Occupational Exposure to Silica, Special Studies and Services Branch, Ontario Ministry of Labour, March 1979 with addendum of September 1982.

3. A Guide for Joint Health and Safety Committees and Representatives in the Workplace, Ontario Ministry of Labour, March 1983.

4. A Guide to the Occupational Health and Safety Act, Ontario Ministry of Labour.

Notes:

Ontario
Ministry of
Labour

Occupational
Health and Safety
Division

400 University Ave.
Toronto, Ontario
M7A 1T7

5M/2/86 ISBN 0-7729-0932-6